

An LED-Based, Laboratory-Scale Solar Simulator for Advanced 3, 4, 5 & 6 Junction Space Photovoltaic Power Systems, Phase II Project

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ABSTRACT

As a result of significant technical effort, the Phase I was successful in delivering a solar simulator prototype that not only proved the initial concept but will significantly reduce future risk and increase our ability to deliver a fully-functional solar simulator in Phase II. The proposed innovation is an LED-based, laboratory-scale, solar simulator. The proposed innovation simulates AM0 response of single, dual, 3, 4, 5 and 6 junction solar cells by using an array of different wavelength LEDs in close proximity to the cell under test. The simulator is adjustable in spectral matching for selected wavelengths and Class A, the highest standard, for spatial uniformity and temporal stability. The solar simulator illuminates a square area 10 inches by 10 inches and includes optical sensors so that all metrics can be calibrated and validated automatically as needed. Solar simulation is critical for all solar cell testing, and current simulators will not work for coming 4, 5 and 6 junction technologies. Because the vast majority of NASA missions rely on solar cells, this is critical, enabling test technology for future solar cells. While accurate solar simulation is critical to all solar cell missions, it is particularly important to missions requiring large amounts of power, such as solar electric propulsion (SEP) missions. Beyond NASA's needs, other members of the aerospace community, including solar cell manufacturers, test labs and research institutions, have a critical need for this capability which presents excellent commercialization opportunities after the Phase II maturation of the technology.

ANTICIPATED BENEFITS

To NASA funded missions:

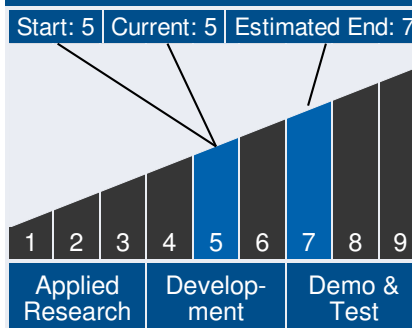
Solar simulation of advanced 4, 5 and 6 junction cells will benefit all NASA missions, particularly high power missions such as solar electric propulsion (SEP). Solar simulation of advanced cells will enable industry standard practices on near-future solar



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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cells. Additional applications include: - Advanced solar cells not currently available, including SBT6J, IMM with greater than 6 junctions and cells with quantum dots - Low intensity, low temperature (LILT) applications - LED-based large area pulsed solar simulation (LAPSS) - Class A AM0 spectral simulation using many more different LED wavelengths - A true AM0 simulator via LED augmentation of lamp-based sources

To the commercial space industry:

All of the potential NASA commercial applications also apply to non-NASA entities, including other government agencies, solar cell manufacturers, aerospace prime contractors, aerospace subcontractors and research institutions. Some of these applications include: - 4" or 6" round illumination area LED-based solar simulators for measuring a single cell, or wafer - 2" or 3" round illumination area LED-based solar simulator for measuring test cells and early research efforts into advanced photovoltaics - Custom testing of advanced cells, including sensitivity studies to selectively current-starved junction testing, selectively current-flooded junction testing, reemission/reabsorption of photons by neighboring junctions and many other tests as researchers see opportunity. - AC modulation of LEDs enables standard AC modulation technique, such as noise reduction through AC modulation, cell capacitance measurements and non-contact I/V measurement of cells before frontside ohmic contacts are added. - Terrestrial technologies, up to 6 junctions, could greatly benefit from the spectral control and flexibility of this instrument. All benefits listed above could apply to terrestrial cells as well, with the greatest benefit for multijunction cells. - Some past partners in other projects have already expressed interest in investing in a potential Phase II-E for commercialization and scale-up into the market.

Management Team (cont.)

Program Manager:

- Carlos Torrez

Project Manager:

- David Wolford

Principal Investigator:

- Casey Hare

Technology Areas

Primary Technology Area:

Space Power and Energy Storage (TA 3)

└ Power Generation (TA 3.1)

└ Solar (TA 3.1.3)

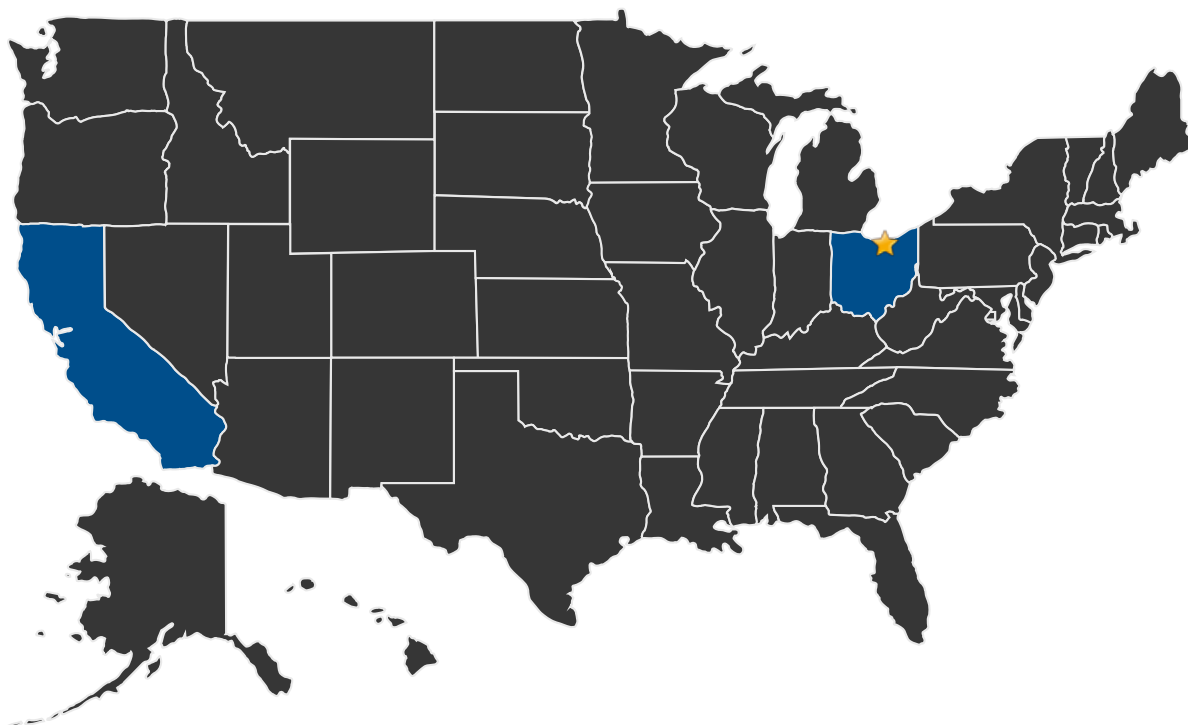
└ Reduced-Cost Photovoltaic Blankets (TA 3.1.3.6)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work ★ **Lead Center:**
Glenn Research Center

Other Organizations Performing Work:

- Angstrom Designs, Inc. (Santa Barbara, CA)
- University of California, Santa Barbara (Santa Barbara, CA)

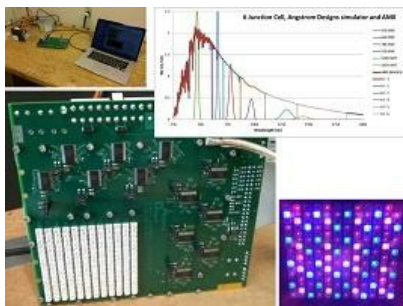
Active Project (2014 - 2016)

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IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

An LED-Based, Laboratory-Scale Solar Simulator for Advanced 3, 4, 5 & 6 Junction Space Photovoltaic Power Systems